

this strategy further enhances the size and portability of these products, it eliminates the increasingly important need to input information and communicate in the field. To date, the information technology industry has been stifled by a lack of acceptable input devices that provide both full size usability and compact portability. As a result, the growth rates and acceptance of many new products, particularly portable electronic devices, have been significantly constrained. Until now, consumers who input information have been forced to sacrifice either size or usability.

OBJECTS OF THE INVENTION

[0012] It is an object of the invention to provide a substantially full size data entry panel with normal key spacing. It is a further object of the invention to make the data entry panel collapsible to a small, compact size. It is another object of the invention that the panel has an acceptable tactile response. It is a final object of the invention that the panel be economically manufactured.

SUMMARY OF THE INVENTION

[0013] The foregoing objects of the invention are satisfied by a collapsible data entry panel of the invention. The panel in its most basic form comprises, an upper layer of flexible sheet material having formed keys on its outer surface and conductive areas or contacts on its inner surface, a lower layer of flexible sheet material having conductive circuits or traces on its inner surface, and a resilient, flexible frame around the peripheral margins of the sheet material layers that pulls the layers taut so that they are parallel to and spaced apart from one another. Depression of a formed key will cause a corresponding, underlying contact to connect with the conductive trace carried by the lower layer, and thereby complete a circuit representative of the depressed key.

[0014] The data entry panel of the invention is collapsible to a surface area less than $\frac{1}{2}$ and as small as $\frac{1}{3}$ of its extended configuration. Specifically, by twisting the respective ends of the panel in opposite directions, while applying a slight inward pressure, the frame flips, twists and collapses upon itself. The collapsed panel typically comprises three lobes, thus having a surface area of about $\frac{1}{3}$ the original size. In its collapsed configuration, the panel can readily fit into a shirt pocket or purse. If the panel is subsequently released, it will automatically spring back to its original, extended configuration.

[0015] The lower layer comprises a flexible, lightweight fabric with independent patterns of circuits (conductive traces) printed in conductive ink on the top or inner surface. Each circuit includes a pair of contact points for each "key." The printed conductive traces, other than the contact points, may be coated with an insulating material(s) to provide protection from wear and tear. The top layer is also formed from a lightweight flexible fabric, but alternatively could comprise a thin, molded polymer material. Preferably, the keys are formed by printing a thick polymer material onto the outer surface of the top layer so as to form a three dimensional key surface that may be felt by the user. Alternatively, the top layer could be molded or embossed to form cup-shaped keys. The inner surface of the top layer contains conductive areas or contacts that correspond to the contact points on the lower layer. Preferably, the top and

bottom layers are insulated from each other by the airspace created by the frame when the fabric is pulled taut.

[0016] Alternatively or in addition, an intermediate layer of fabric is inserted between the top and bottom layers, particularly when the independent patterns of circuits (conductive traces) are separated and printed on the opposing top and bottom layers. The intermediate layer has a pattern of holes that correspond to the contact points. Thereby the intermediate layer allows the contact points to meet (when a "key" is depressed) but otherwise insulates the top and bottom traces from any unintended short circuits.

[0017] The frame is preferably a hoop of spring steel. In its opened or extended configuration, the frame pulls the two layers taut, creating an airspace between layers to insulate the upper and lower conductive traces.

[0018] The present invention is a creative and unique solution to previously insurmountable problems in the art. Input devices based on this design offer standard functionality when opened, and compact easy portability when closed. Depending on the materials used, the weight of the data entry panel can be a fraction of comparable full sized devices. They can also be designed to closely match user preferences, both functional and ornamental, and to interface with a wide variety of electronic equipment.

[0019] The data entry panel of the invention has applicability as a full-sized computer keyboard or can be used for other input devices, such as musical keyboards, numerical keypads, and specialized keyboards. The panel is slim, flexible and lightweight. It provides conventional utilization in terms of a full-size layout, standard key spacing and proper tactile response, while also having the ability to be compressed to a compact size. When the panel is not in use it is reduced to about one-third its size by twisting and collapsing the frame and structure onto itself and forming (three) joined sections. In this manner, the panel is reduced to approximately the size of a thin doughnut and stored comfortably on a belt or in a shirt pocket or purse. This flexibility allows the data entry panel of the invention to be employed as a stand alone peripheral, or to be integrated with other components, such as microprocessors and displays, to become a self-contained handheld device. For example, the surface areas that form the three lobes when the unit is collapsed (the areas that substantially do not fold or bend) could house additional microprocessors, displays, power supplies, etc. By adding flexible displays and circuits throughout the unit a stand-alone computer, wireless telephone, or other device can be created.

[0020] These and other objects and advantages of the invention will become apparent from the following detailed description as considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is a plan view of the collapsible data entry panel of the invention in an extended, panel configuration.

[0022] FIG. 2 is a plan view of the collapsible data entry panel of the invention in a collapsed, compact configuration.

[0023] FIG. 3 is a side elevational view of the data entry panel of the invention in the collapsed, compact configuration.